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SILVICULTURAL CONTROL OF DWARF MISTLETOE IN YOUNG LODGEPOLE PINE STANDS: ESTABLISHMENT REPORT

Frank G. Hawksworth

ESTABLISHMENT REPORT

SILVICULTURAL CONTROL OF DWARF MISTLETOE IN YOUNG LODGEPOLE PINE STANDS

(Study 2301, E-18)

By

Frank G. Hawksworth and Wilmer F. Bailey

U. S. FOREST SERVICE

ROCKY MOUNTAIN REGION

AND

ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

JANUARY 1967

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EXPERIMENT STATION

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SILVICULTURAL CONTROL OF DWARF MISTLETOE

IN YOUNG LODGEPOLE PINE STANDS

As explained in the Study Plan (Appendix I) the objective of this study is to develop guides to help forest managers decide on which young mistletoe-infected lodgepole pine stands can be sanitized and which should be destroyed and a new stand started.

Personnel

The plots were established by J. L. Stewart (1965, 1966), A. E. Landgraf (1965), and W. F. Bailey (1966) of the Rocky Mountain Region and T. E. Hinds (1965, 1966) and F. G. Hawksworth (1965, 1966) of the Rocky Mountain Station. In addition, the assistance of Ranger E. A. Crozer and his staff of the North Park District is gratefully acknowledged.

Plot Establishment

A total of 37 half-acre plots in different age classes (from 17 to 41 years old) and with various amounts of mistletoe infection (from none up to 75 percent of the trees infected) were established. Most of the plots (29) are on the North Park District of the Routt National Forest, Colorado; the others are in adjacent areas of the Sulphur District, Arapaho National Forest and Laramie River District, Roosevelt National Forest.

The age class, infection class, and treatment for each of the 37 plots established are summarized in Table I. Because of the ages of stands encountered in the field, it was decided to place plots in three 10-year age classes (15-24, 25-34, and 35-44) instead of four classes (11-20, 21-30, 31-40, and 41-50) as proposed in the original study plan. The original goal was to have 2 plots in each age category, but this was not possible in all cases because suitable plots could not be located. A total of 34,575 trees were examined on the plots.

The data on Plots 1 through 11 and 13 through 19 were recorded in June and August 1965 and Plots 12 and 20 through 37 in June and July 1966. A summary of the individual plot data is given in Table II.

Most plots are square except for Nos. 6, 31, and 34 which were made rectangular to keep within the desired age and infection classes (Table II). The original plan was to have the plots an even 0.50 acre in size or 2.24 chains on a side. However, due to pilot error, it was found that after several plots were established that the actual distance used was 2.17 chains or 0.47 acre. This size was then used for the first 25 plots (except plot 6). Plots 26 through 37 contain a full 0.50 acre.

A 6-foot metal fence post has been placed at the corner of each plot and also at the interior corner of each intensive plot.

Table I. Plot Summary.

Percent Infection	Treatment	Age Class (Years) 15-24 No. of Plots	15-24 Plot Nos.	25-34 No. of Plots	25-34 Plot Nos.	35-44 No. of Plots	35-44 Plot Nos.
None	None	1	(6)	2	(22, 27)	2	(13, 18)
	TSI	1	(34)	1	(23)	2	(14, 19)
0-20%	None	4	(7,8,9,10)	2	(25, 32)	--	--
	DM+TSI	2	(2, 5)	2	(21, 28)	1	(15)
21-40%	None	2	(35, 36)	2	(26, 31)	--	--
	DM+TSI	3	(1, 3, 4)	2	(29, 37)	--	--
41-60%	None	--	--	2	(24, 33)	--	--
	DM+TSI	--	--	2	(20, 30)	1	(12)
61-80%	None	--	--	--	--	1	(11)
	DM+TSI	--	--	--	--	2	(16, 17)

Table II. Individual plot summaries.

Plot Number	Mean Age (1965)	Treatment[1/]	Young Stand			Number of Infected Overstory Trees	Intensive Plot Size - Acres	Main Plot	
			All Trees	DM	% DM[2/]			Size Acres	Dimensions Chains
1	17	DM (65) + TSI	457	108	24	16	.05	.47	2.17 sq.
2	17	DM (65) + TSI	1230	153	12	9	.025	.47	2.17 sq.
3	17	DM (65) + TSI	1193	347	29	54	.025	.47	2.17 sq.
4	17	DM (65) + TSI	810	171	21	25	.025	.47	2.17 sq.
5	17	DM (65) + TSI	1101	39	4	5	.025	.47	2.17 sq.
6	17	None	667	3	(0.4)	0	.05	.28	1.4 x 2.0
7	17	None	389	65	17	20	.05	.47	2.17 sq.
8	17	None	988	154	16	66	.05	.47	2.17 sq.
9	18	None	1287	143	11	25	.05	.47	2.17 sq.
10	18	None	977	52	5	6	.05	.47	2.17 sq.
11	41	None	1163	777	67	30	.05	.47	2.17 sq.
12	41	DM (66) + TSI	723	355	49	0	.05	.47	2.17 sq.
13	41	None	1148	0	0	0	.05	.47	2.17 sq.
14	41	TSI	547	0	0	0	.05	.47	2.17 sq.
15	41	DM (65) + TSI	1317	150	11	0	.025	.47	2.17 sq.
16	41	DM (65) + TSI	890	601	68	0	.025	.47	2.17 sq.
17	41	DM (65) + TSI	768	577	75	20	.025	.47	2.17 sq.
18	41	None	2150	0	0	0	.025	.47	2.17 sq.
19	41	TSI	1751	0	0	0	.025	.47	2.17 sq.
20	27	DM (66) + TSI	1092	504	46	0	.025	.47	2.17 sq.
21	27	DM (66) + TSI	490	100	20	0	.025	.47	2.17 sq.
22	27	None	209	0	0	0	.025	.47	2.17 sq.
23	27	TSI	799	0	0	0	.025	.47	2.17 sq.
24	27	None	540	222	41	14	.025	.47	2.17 sq.
25	27	None	464	90	19	2	.025	.47	2.17 sq.

(continued)

Table II. (continued)

Plot Number	Mean Age (1965)	Treatment 1/	Young Stand			Number of Infected Overstory Trees	Intensive Plot Size - Acres	Main Plot	
			All Trees	DM	% DM 2/			Size Acres	Dimensions Chains
26	27	None	1526	327	21	3	.025	.50	2.24 sq.
27	27	None	1566	12	(0.8)	3	.025	.50	2.24 sq.
28	27	DM (66) + TSI	986	41	4	2	.025	.50	2.24 sq.
29	27	DM (66) + TSI	1026	322	31	31	.025	.50	2.24 sq.
30	27	DM (66) + TSI	620	310	50	57	.025	.50	2.24 sq.
31	27	None	924	203	22	12	.025	.50	1.5 x 3.33
32	27	None	952	123	13	6	.025	.50	2.24 sq.
33	27	None	862	534	62	30	.025	.50	2.24 sq.
34	17	TSI	665	9	(1.4)	0	.025	.50	1.5 x 3.33
35	16	None	596	236	40	25	.025	.50	2.24 sq.
36	16	None	1009	278	28	8	.025	.50	2.24 sq.
37	27	DM (66) + TSI	693	188	27	11	.025	.50	2.24 sq.

1/ DM = Mistletoe sanitation; year completed is in parentheses 1965 or 1966.
TSI = To be done at time of second treatment.

2/ The infected trees were cut on the 3 plots (6, 27 and 34) with very low infection percentages (in parentheses) and were then considered as healthy.

The plots have also been marked by "Forest Research" signs (FS 1514) at 1/2 to 1 chain intervals around each plot or group of plots. The rangers of each of the three districts involved have been informed of the locations of these plots, and they have been entered on the work atlases for each district.

Sanitation

Sanitation consisted of cutting of all visibly mistletoe-infected trees on the plots and in a half-chain-wide isolation strip around each plot. No pruning was attempted. As shown in Table II, 15 plots were treated--eight in 1965 (Plots 1, 2, 3, 4, 5, 15, 16, 17) and seven in 1966 (Plots 12, 20, 21, 28, 29, 30, 37).

Intensive Plots

For study of intensification of infection, intensive plots were established in two opposite corners in each half-acre plot. The size of the intensive plots varied with the density of the stand. For dense stands (usually those with over 500 trees on the entire plot) intensive plots 0.025 acres (0.5 chains square) were used. For less dense stands, intensive plots of 0.05 acres were used (0.707 chains square).

For healthy and untreated plots, each tree (over 6 feet high) in the intensive plots was tagged. For the treated plots, only the uninfected trees were tagged, but data were also recorded for trees cut. A total of about 3,400 trees was tagged on all plots. The height (to nearest foot), d.b.h. (to closest 0.1 inch), crown class, and degree of mistletoe infection (6-class system) were recorded for each live tree on the intensive plots. Maintenance of data on the intensive plots will be a responsibility of the Rocky Mountain Station.

Plot Locations

The location of the 37 plots is shown on both maps and aerial photographs as follows:

Plot Numbers	Designation	National Forest	Locator Map	Aerial Photograph	Plot Diagram
1	Camp Creek North	Routt	1	1	1
2-8	Camp Creek Northeast	Routt	1	1	2
9-10	Boswell Creek	Roosevelt	1	2	3
11-14	Camp Creek West	Routt	1	3	4
15-19	Camp Creek Main	Routt	1	3	5

Plot Numbers	Designation	National Forest	Locator Map	Aerial Photograph	Plot Diagram
20-25	Willow Creek	Arapaho	2	4	6
26-32	Silver Creek Main	Routt	3	5, 7	7
33	Silver Creek West	Routt	3	5	8
34-36	Bear Draw	Routt	1	6	9
37	Silver Creek East	Routt	3	7	10

The plot diagrams are drawn to scale and show plot location and orientation and location of the intensive plots and their designations.

Motor logs to locate each plot or group of plots are given in Appendix II.

Future Plans

The study plans call for a second mistletoe sanitation 5 years after the plots were first treated. However, some plots were established in 1965 and some in 1966. From the standpoint of convenience in scheduling and treating these plots, it would be best to treat all plots at one time--probably in 1970. However, the plots should be examined in about 1969 to determine whether this operation might be best delayed until 1971. In any case, subsequent examinations should be made at 5, 10, and 15 years after the second treatment.

As outlined in the study plan, the 15 treated plots will be thinned using Regional TSI guides at the time of the second treatment. In addition, 4 uninfected plots (Plots 14, 19, 23, and 34) will be thinned at the same time.

A progress report is planned after the 10-year examination and a final report after 20 years. The intermediate examinations at 5 and 15 years will probably also yield information that will be useful in modification of control practices.

The general impression gained during the establishment of this study was that the plots in the 27-year age class will be most critical in yielding information on control. Preliminary observations suggest that sanitation will be feasible in the 16- to 18-year-old stands but probably not in the 41-year-old stands. In the latter, infection was usually so heavy that sanitation as practiced in this study resulted in essentially clear-cut patches.

APPENDIX I

STUDY PLAN

SILVICULTURAL CONTROL OF DWARFMISTLETOE

IN YOUNG LODGEPOLE PINE STANDS

A proposed U. S. Forest Service cooperative study between the Rocky Mountain Region, Denver, and the Rocky Mountain Forest and Range Experiment Station, Fort Collins.

PREPARED BY

James L. Stewart

BRANCH OF PEST CONTROL, R-2

APPROVED:

ROCKY MOUNTAIN REGION

/s/ D. S. NORDWALL	3/30/65
REGIONAL FORESTER	DATE

ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

/s/ RAYMOND PRICE	4/16/65
DIRECTOR	DATE

SILVICULTURAL CONTROL OF DWARFMISTLETOE

IN YOUNG LODGEPOLE PINE STANDS

1. Problem

Region 2 has a large acreage of young (up to 50 years old) lodgepole pine stands that are infected with dwarfmistletoe, Arceuthobium americanum. These are a result of cutting infected stands and not destroying the remaining infected overstory trees or of trees remaining after natural catastrophe. If acceptable yields are to be obtained from these stands, we must decide to either destroy them and start over or try to sanitize them. What we need to know is, for a given aged stand, what is the maximum percentage of infected trees we can have and still successfully sanitize.

2. Objectives

The objective of this study is to obtain some guides on which to base our decision of whether to destroy a stand or sanitize.

3. Plot Establishment

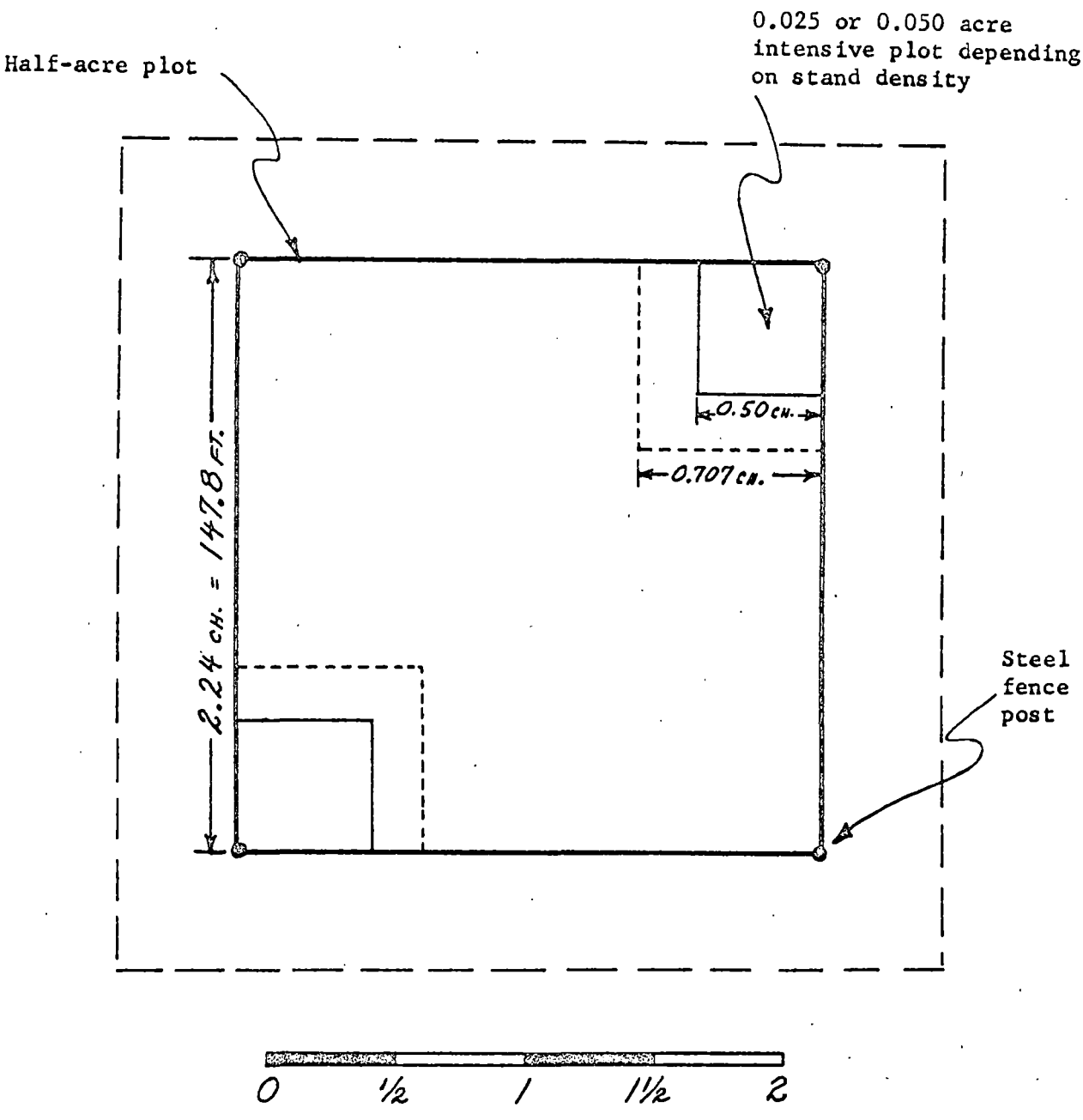
One-half acre square plots plus a thirty foot isolation strip on each side will be established according to the following table. Two plots will be established in each age-infection class-treatment category.

Percent Infection	Treatment	Age Classes (Years) A 10 - 20	B 21 - 30	C 31 - 40	D 41 - 50
I (None	None	2[1]	2	2	2
(None	TSI[2]	2	2	2	2
II (0-20%	None	2	2	2	-
(0-20%	DM[3] + TSI	2	2	2	-
III (20-40%	None	-[4]	2	2	2
(20-40%	DM + TSI	-	2	2	2
IV (40-60%	None	-	-	2	2
(40-60%	DM + TSI	-	-	2	2
V (60-80%	None	-	-	-	2
(60-80%	DM + TSI	-	-	-	2

1/ Number of plots.
2/ T.S.I. stands for timber stand improvement.
3/ D.M. stands for dwarfmistletoe.
4/ Age-infection classes that probably won't be available in the field.

Within each half-acre plot, two square sub-plots will be established for intensive measurement purposes and for studies of dwarf-mistletoe spread and intensification. They will be located in two randomly selected corners. Their size will vary depending on the stocking density of the one-half acre plot. If the half-acre plot contains 500 or more trees, the sub-plots will be 0.025 acres each (0.5 chains square). If the half-acre plot contains less than 500 trees, the sub-plots will be 0.05 acres each (0.707 chains square).

The plot design will be as shown in the following diagram:


Half-acre plot
0.025 or 0.050 acre intensive plot depending on stand density
0.50 CH.
0.707 CH.
2.24 CH. = 147.8 FT.
Steel fence post
0
½
1
1½
2
Scale: Chains

PLOT LAYOUT

The corners of each of the half-acre plots will be marked with five-foot metal posts. "Forest research" (FS 1514) signs shall be placed at one-hundred foot intervals around each plot.

Plots will be located on the Roosevelt, Routt, and Arapaho National Forests. A memorandum designating the location and type of treatment of each plot will be sent to the District.

4. Treatment

The treatment shall consist primarily of cutting infected trees. A limited amount of pruning of infected branches will be done if certain trees are needed for adequate stocking and if infections are few and more than four inches from the bole. White tree marking paint will be used to mark trees that were pruned. All trees older than the general age class will also be cut.

Five years after this is done, the plots will again be sanitized along with other T.S.I. work. Thinning will be done according to the Regional thinning guides for lodgepole pine.

The plots in the uninfected stands will receive T.S.I. work at the same time as the infested stands. The check plots will receive no treatment.

5. Necessary Data

Data will be recorded at establishment (1965) and in 1970, 1975, 1980, and 1985. Stocking and percent dwarfmistletoe infection will be determined by a 100 percent cruise of the plots. Stocking shall be determined prior to first treatment and after each treatment.

On the sub-plots each tree will be tagged. The d.b.h., height, crown class, and amount of infection will be recorded for each tree.

Man hours spent on each treatment will be recorded.

6. Reports

A progress report on the study will be prepared after the 1975 readings. However, it is possible that some useful information will result from the analyses of the data from the 1970 (5-year) examination. A final report is planned after the 1985 (20-year) examination.

7. Personnel

This study will be a cooperative project between the Branch of Pest Control (Amel E. Landgraf, James L. Stewart) and the Division of Forest Disease Research of the Rocky Mountain Forest and Range Experiment Station (Frank G. Hawksworth, Thomas E. Hinds).

Establishment and stand treatment will begin in the spring of 1965 and will be done jointly by the two members of each organization. The Branch of Pest Control will have primary responsibility for maintenance of records on the 0.5 acre plots, and the Rocky Mountain Station will have primary responsibility for recording information on the intensive sub-plots.

Over the twenty-year period it is estimated that this study will require 160 man days to be divided as such:

Year	Estimated Man Days		Tasks
	Admin.	Research	
1965	40	40	Establish plots, DM treatment, record data
1970	15	15	Second DM treatment, T.S.I., record data
1975	10	10	Record data, prepare progress report
1980	5	5	Record data
1985	10	10	Record data, prepare final report
	80	80	

8. Costs (Other than salaries, travel, and per diem)

208 five-foot metal posts	$160.00
2 cases white tree marking paint (GSA 2010-619-2882)	10.00
400 signs (FS 1514)	42.00
	$212.00

APPENDIX II

Motor Logs to Plots (as of 1966)

Plots 1 to 10 (Camp Creek North and Northeast and Boswell Creek)

Miles	
0.0	Go SW from Colo.-Wyo. line on Colo. 127.
0.2	Junction, go SE.
0.4	Plot 1 on right.
0.7-0.8	Plots 2 to 8 on right.
1.8	Junction, turn right.
2.0	Old mill site, keep right (south).
2.1	Cross draw.
2.35	Junction, turn left.
2.45	Plot 9 on right, 10 on left.

Alternate route to Plots 9 and 10 (Boswell Creek)

Miles	
0.0	Go east from Colo.-Wyo. line on Wyo. 230.
0.65	Junction, turn south.
1.1	Junction, straight ahead.
1.3	Old mill site, keep right (south).
1.4	Cross draw.
1.65	Junction, turn left.
1.75	Plot 9 on right, 10 on left.

Plots 11 to 14 (Camp Creek West)

Miles	
0.0	Go south on Colo. 127 from Colo.-Wyo. line.
0.7	Cross railroad tracks.
1.4	Plots 11-14 are ca. 1/4 mile E of highway and 2 chains E of railroad.

Plots 15 to 19 (Camp Creek Main)

Miles	
0.0	Go south on Colo. 127 from Colo.-Wyo. line.
0.7	Cross railroad tracks.
1.1	Turn east on poor road.
1.7	Cross railroad tracks.
1.95	Turn east across creek (beware of bridge!).
2.1	Plots 15-17 on left, 18 and 19 on right.

Plots 20 to 25 (Willow Creek)

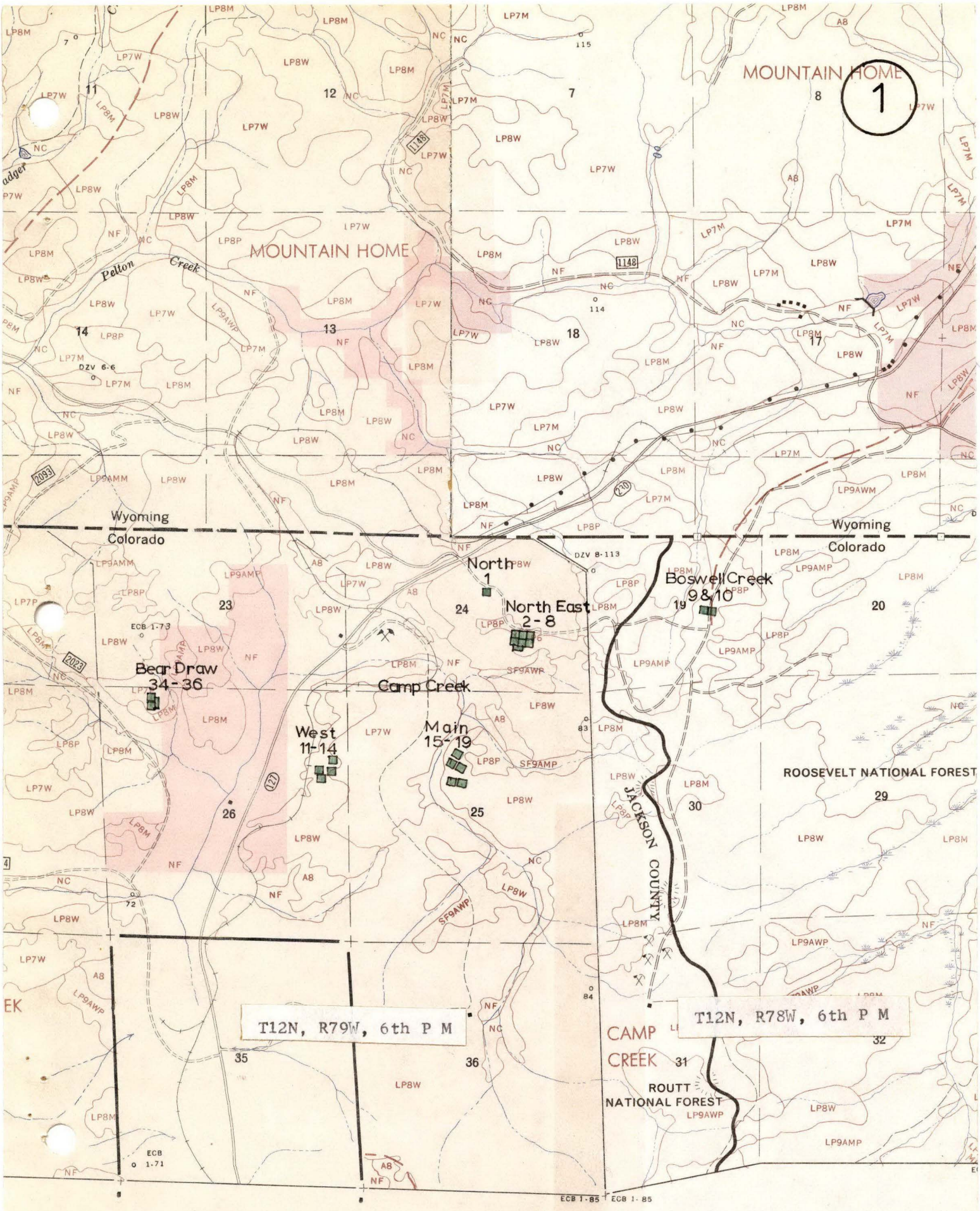
Miles	
0.0	Go south from summit of Willow Creek Pass on Colo. 125.
1.4	Plots 20-25 ca. 5 chains north of road north of borrow pit.

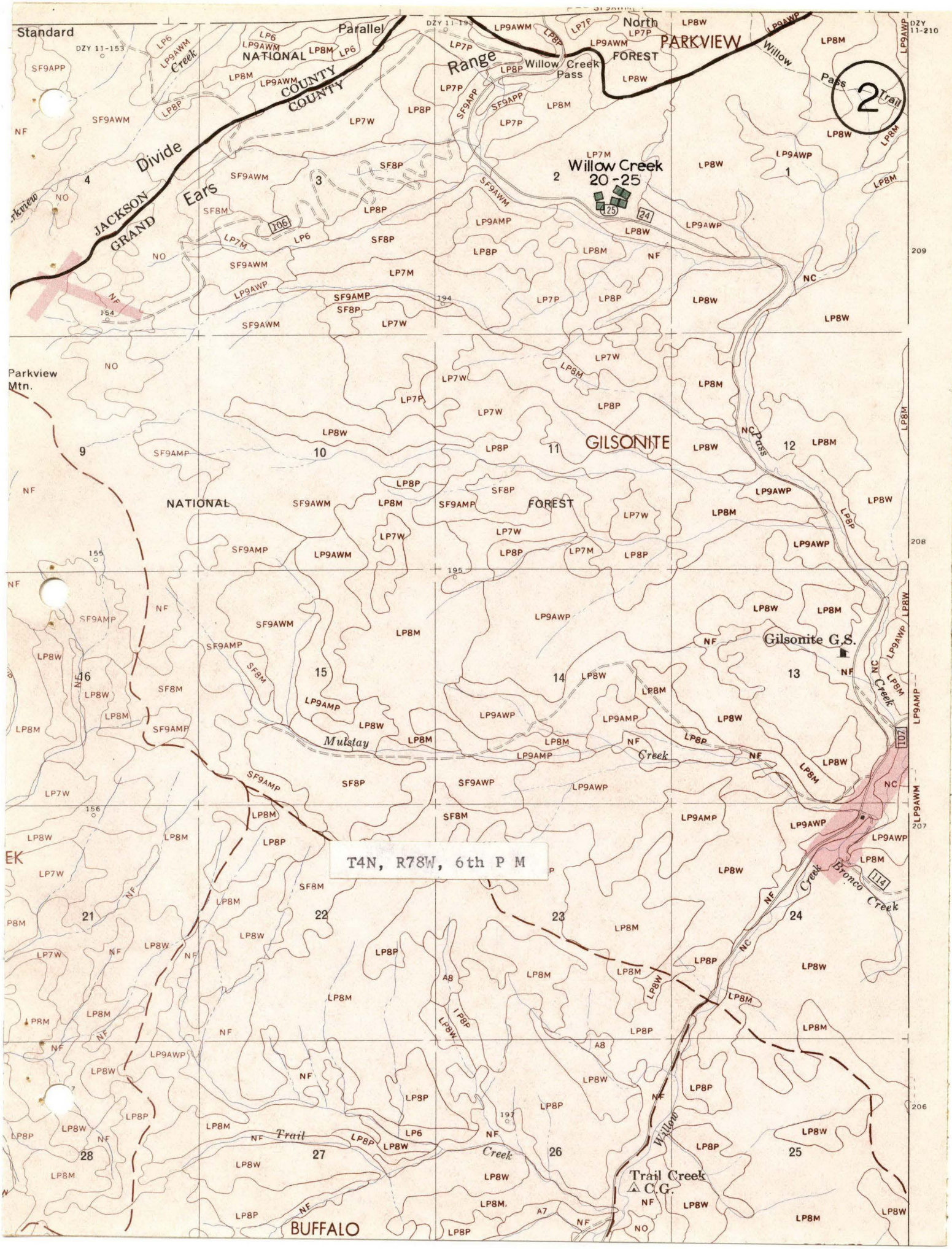
Plots 26 to 33 and 37 (all Silver Creek plots)

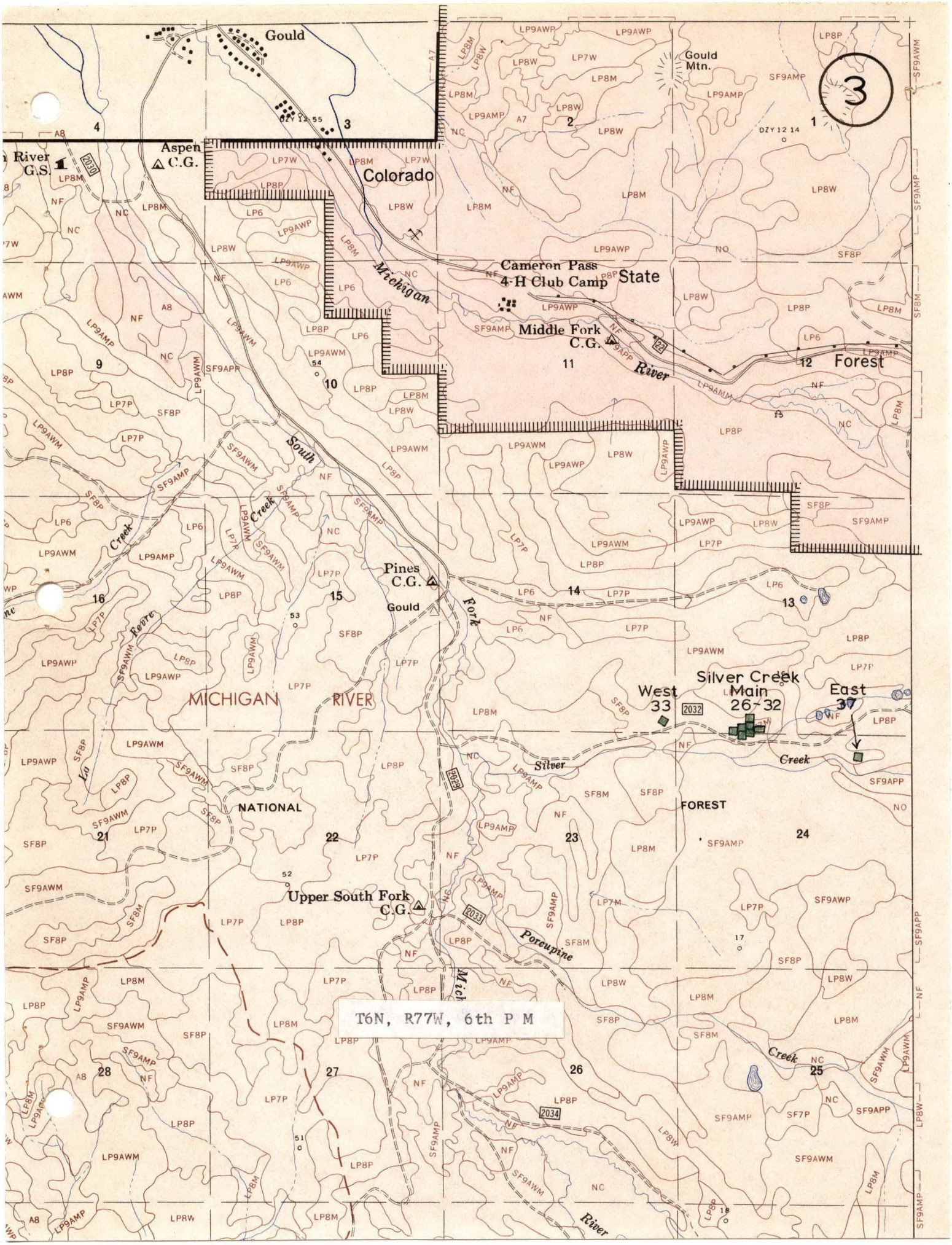
Miles	
0.0	Go south from Gould on Teller City Road (FS 2029).
0.7	National Forest boundary.
4.0	Turn east on Silver Creek Road.
4.1	Cross Michigan River.
4.7	Junction, keep left.
5.0	Plot 33, north side of road.
5.5-5.6	Plots 26 to 32, north side of road.
6.6	Junction, keep right.
6.65	Junction, keep left.
6.75	Plot 37, south side of road.

Plots 34 to 36 (Bear Draw)

Miles	
0.0	Go south on Colo. 127 from Colo.-Wyo. line.
0.7	Cross railroad tracks.
1.7	Junction, turn west.
2.3	Turn north just west of cattle guard at National Forest boundary.
3.1	Plots 34 to 36 are about 10 chains N 20° E across Bear Draw.


MOUNTAIN HOME
1
Pelton Creek
MOUNTAIN HOME
Wyoming
Colorado
Wyoming
Colorado
North 1
North East 2-8
Boswell Creek 9&10
Bear Draw 34-36
Camp Creek
West 11-14
Main 15-19
JACKSON COUNTY
ROOSEVELT NATIONAL FOREST
ROUTT NATIONAL FOREST
CAMP CREEK
T12N, R79W, 6th P M
T12N, R78W, 6th P M
ECB 1-73
DZV 6-6
DZV 8-113
ECB 1-71
ECB 1-85
ECB 1-85


Standard
Parallel
NATIONAL
COUNTY
COUNTY
Range
North
PARKVIEW
FOREST
Willow Creek
Pass
Willow
Pass
Trail
2
Divide
JACKSON
GRAND
Ears
Willow Creek
20-25
Parkview
Mtn.
GILSONITE
NC Pass
NATIONAL
FOREST
Gilsonite G.S.
NC Creek
Mulstay
Creek
Bronco
Creek
T4N, R78W, 6th P M
Trail
Creek
Willow
Creek
Trail Creek
A.C.G.
BUFFALO
DZY 11-153
DZY 11-193
DZY 11-210
106
107
114
24
425
194
195
197
155
156
164


3
Gould
Aspen
C.G.
Colorado
Gould
Mtn.
Cameron Pass
4-H Club Camp
State
Michigan
River
Middle Fork
C.G.
Forest
South
Fork
Pines
C.G.
Gould
MICHIGAN
RIVER
West
33
Silver Creek
Main
26-32
East
37
Silver
Creek
NATIONAL
FOREST
Upper South Fork
C.G.
Porcupine
Creek
T6N, R77W, 6th P M

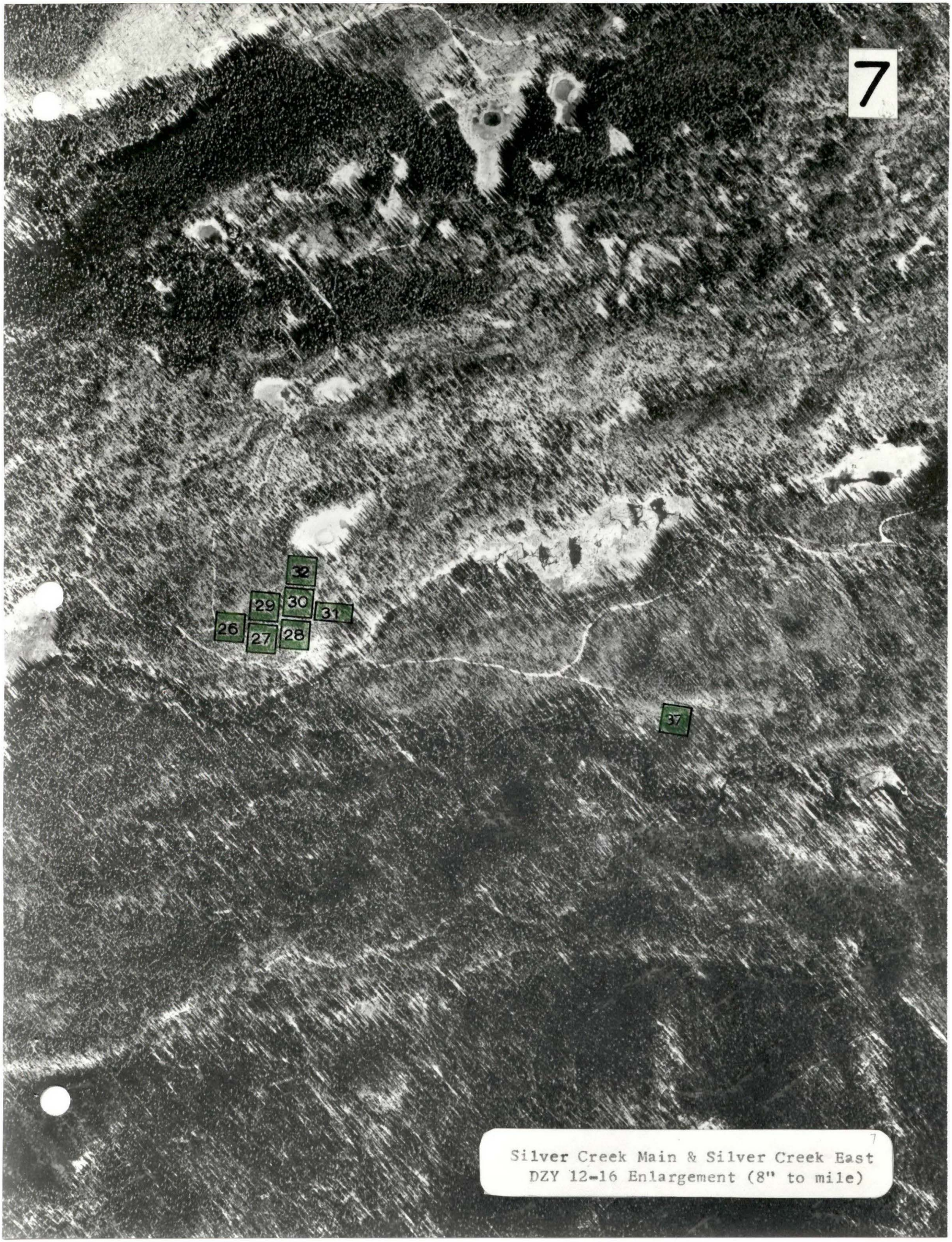
Camp Creek North & Camp Creek Northeast
ECB 1-83 Enlargement (8" to mile)

Camp Creek Main & Camp Creek West
ECB 1-83 Enlargement (8" to Mile)

Willow Creek
DZY 11-193 Enlargement (8" to mile)

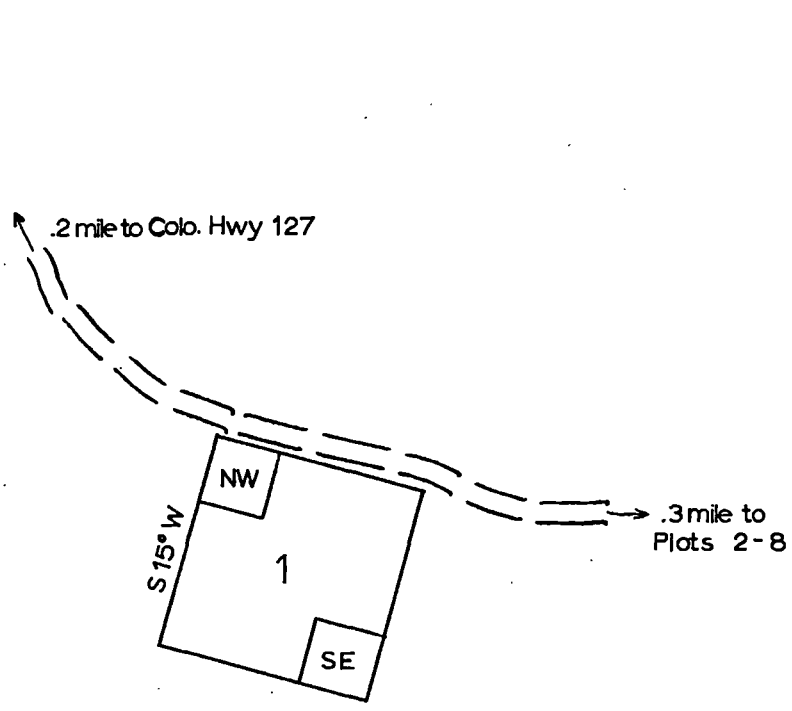
Silver Creek Main & Silver Creek West
DZY 12-16 Enlargement (8" to mile)

Bear Draw
ECB 1-73 Enlargement (8" to mile)
6
36
35
3
4

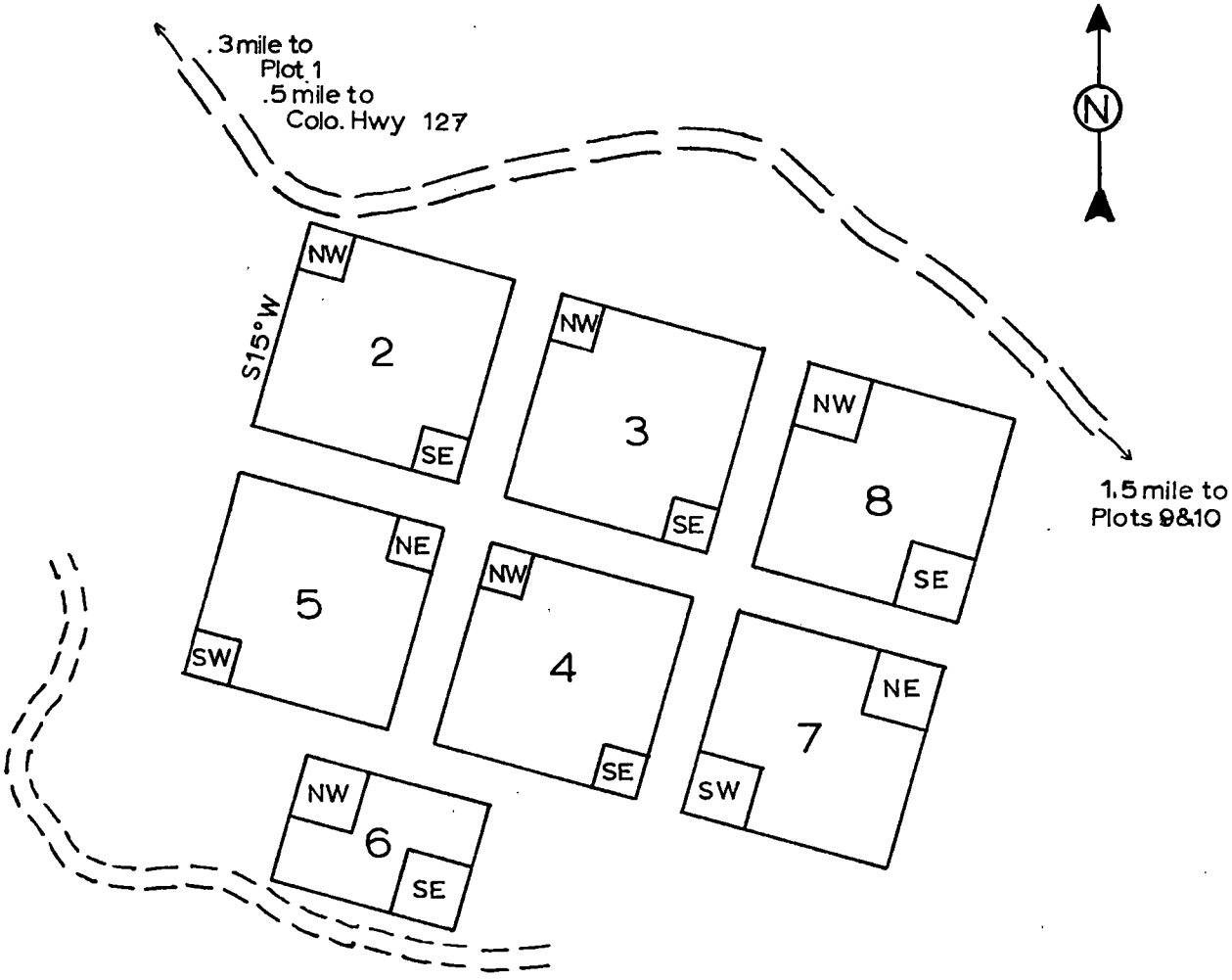


Silver Creek Main & Silver Creek East
DZY 12-16 Enlargement (8" to mile)

1

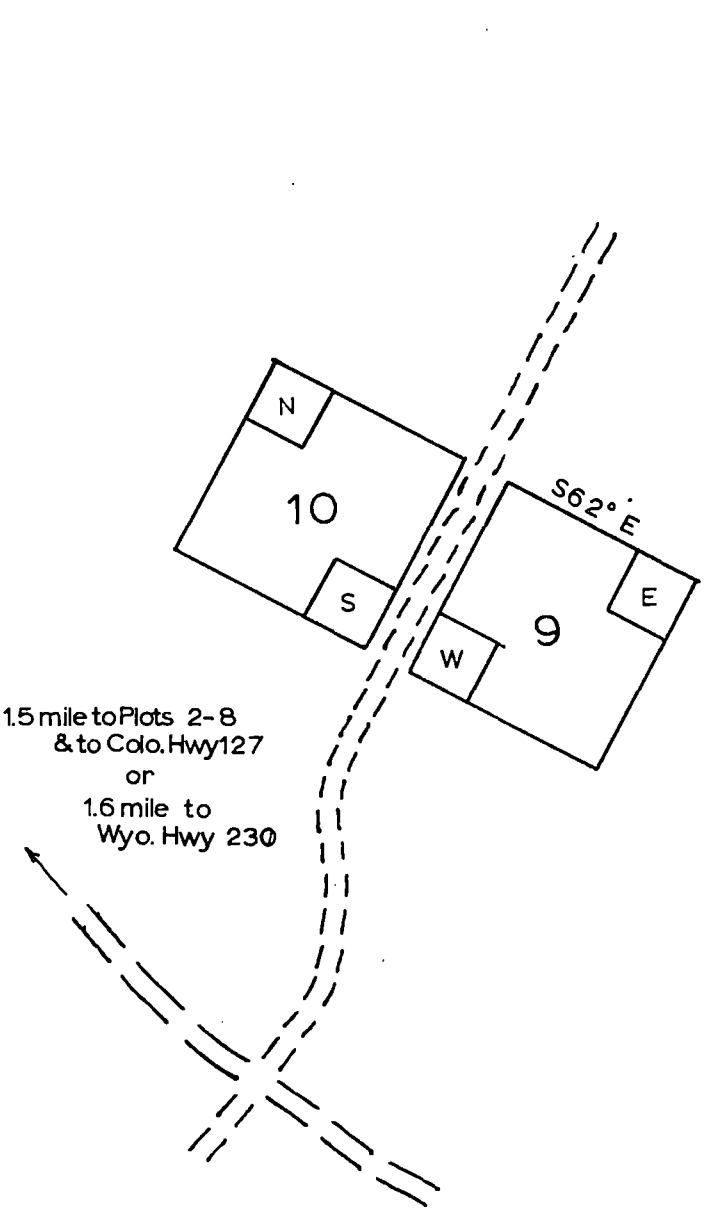


Camp Creek North
Dwarfmistletoe Control Plot
Sec. 24, T12N, R79W., 6th P. M.
Routt National Forest
Established 6/65
Scale: 1 inch = 2 chains



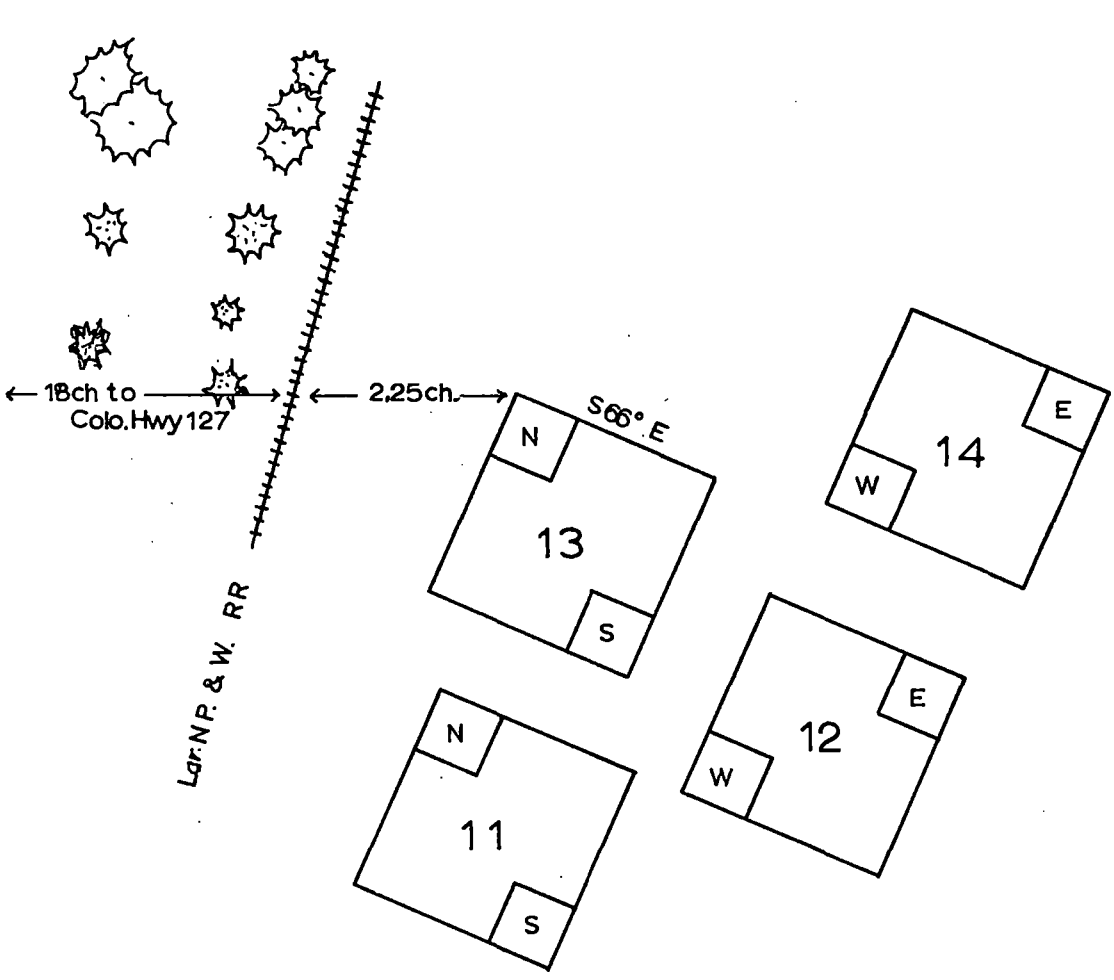
Camp Creek North East
Dwarfmistletoe Control Plots
Sec. 24, T12N, R79W, 6th P. M.
Routt National Forest
Established 6/65

Scale: 1 inch = 2 chains



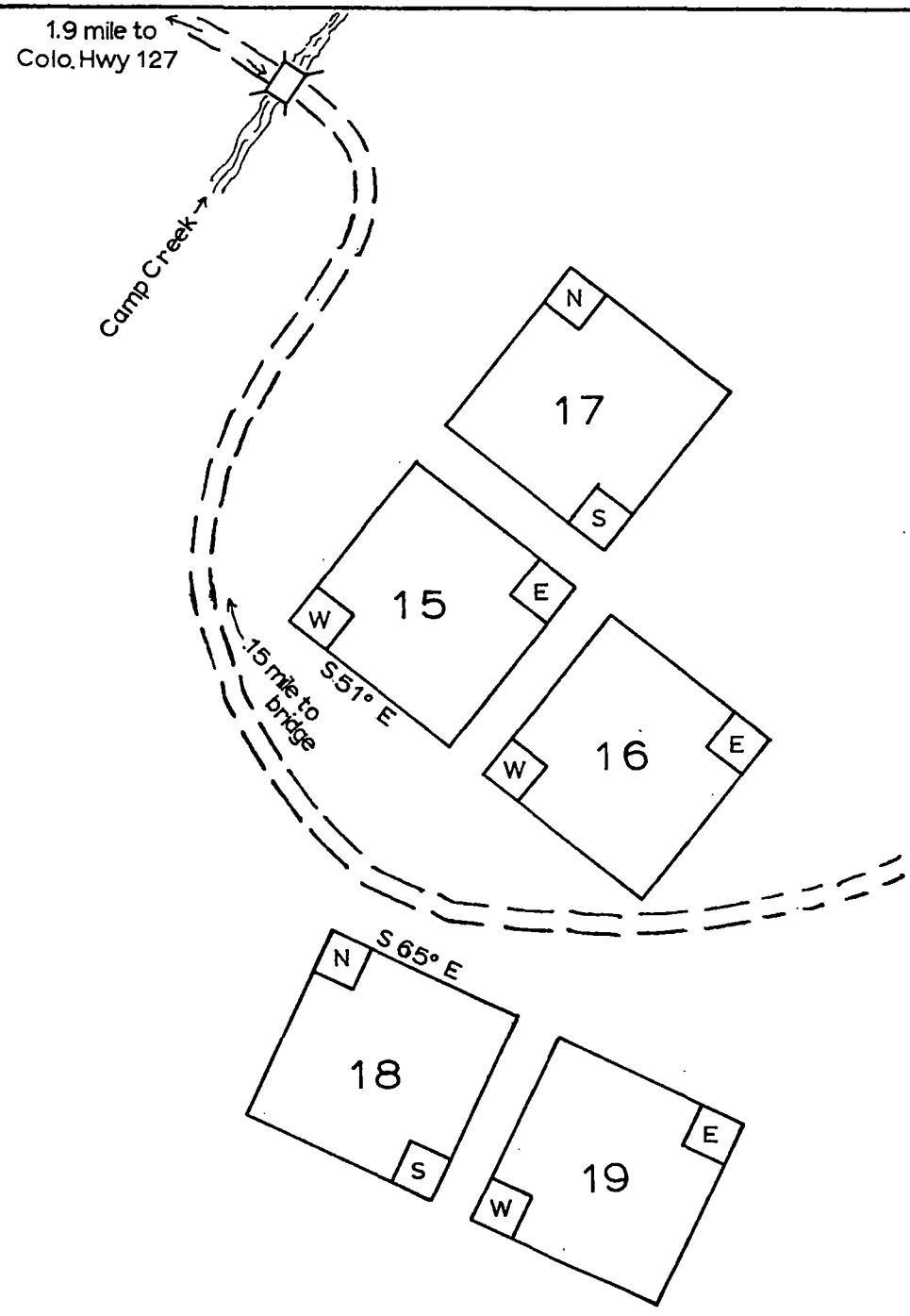
Boswell Creek
Dwarfmistletoe Control Plots
Sec. 19, T 12N, R 78W, 6th P. M.
Roosevelt National Forest
Established 6/65

Scale: 1 inch = 2 chains



Camp Creek West
Dwarfmistletoe Control Plots
Sec. 26, T12N, R79W, 6th P. M.
Routt National Forest
Established 6/65

Scale: 1 inch = 2 chains

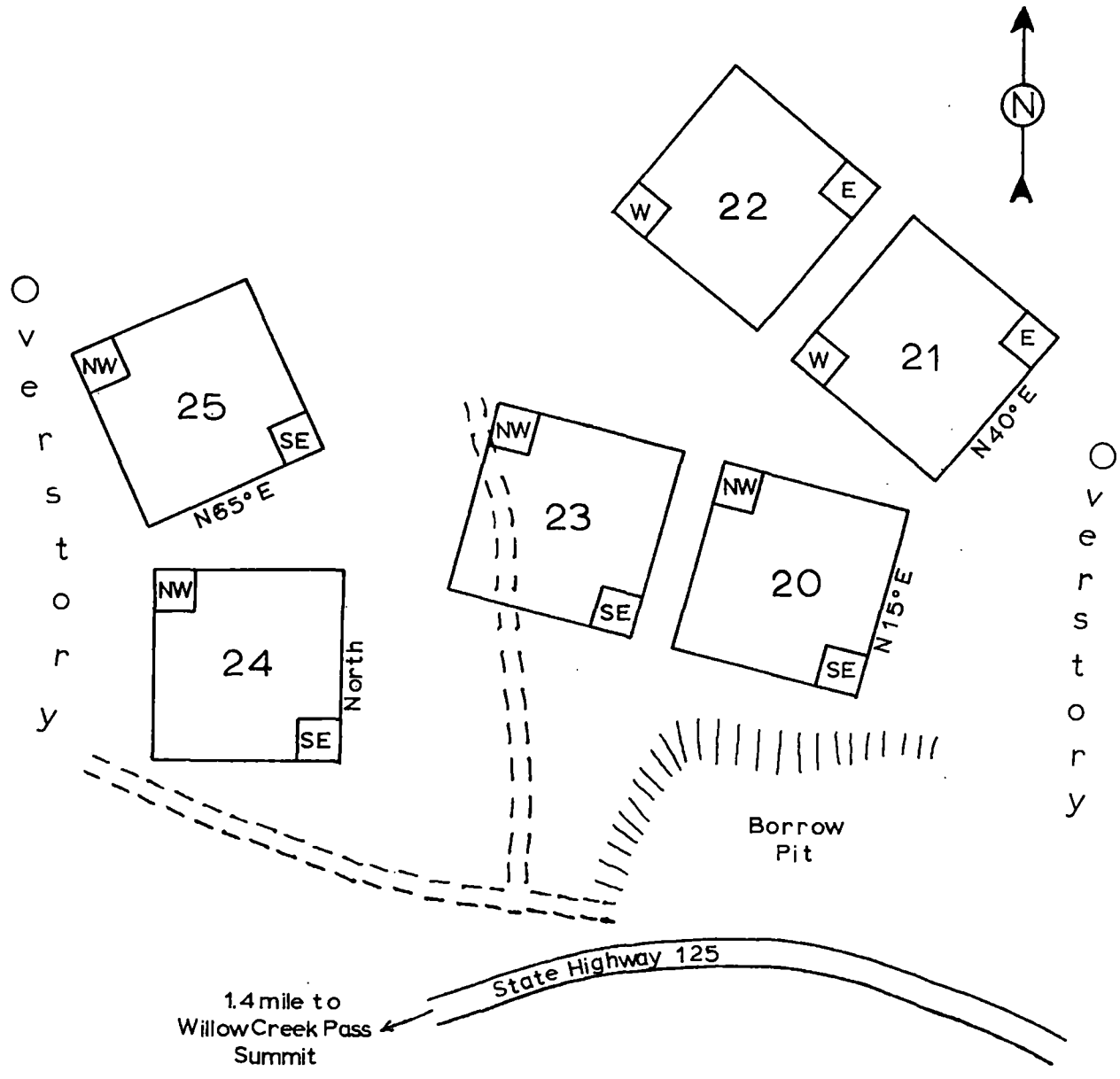


5

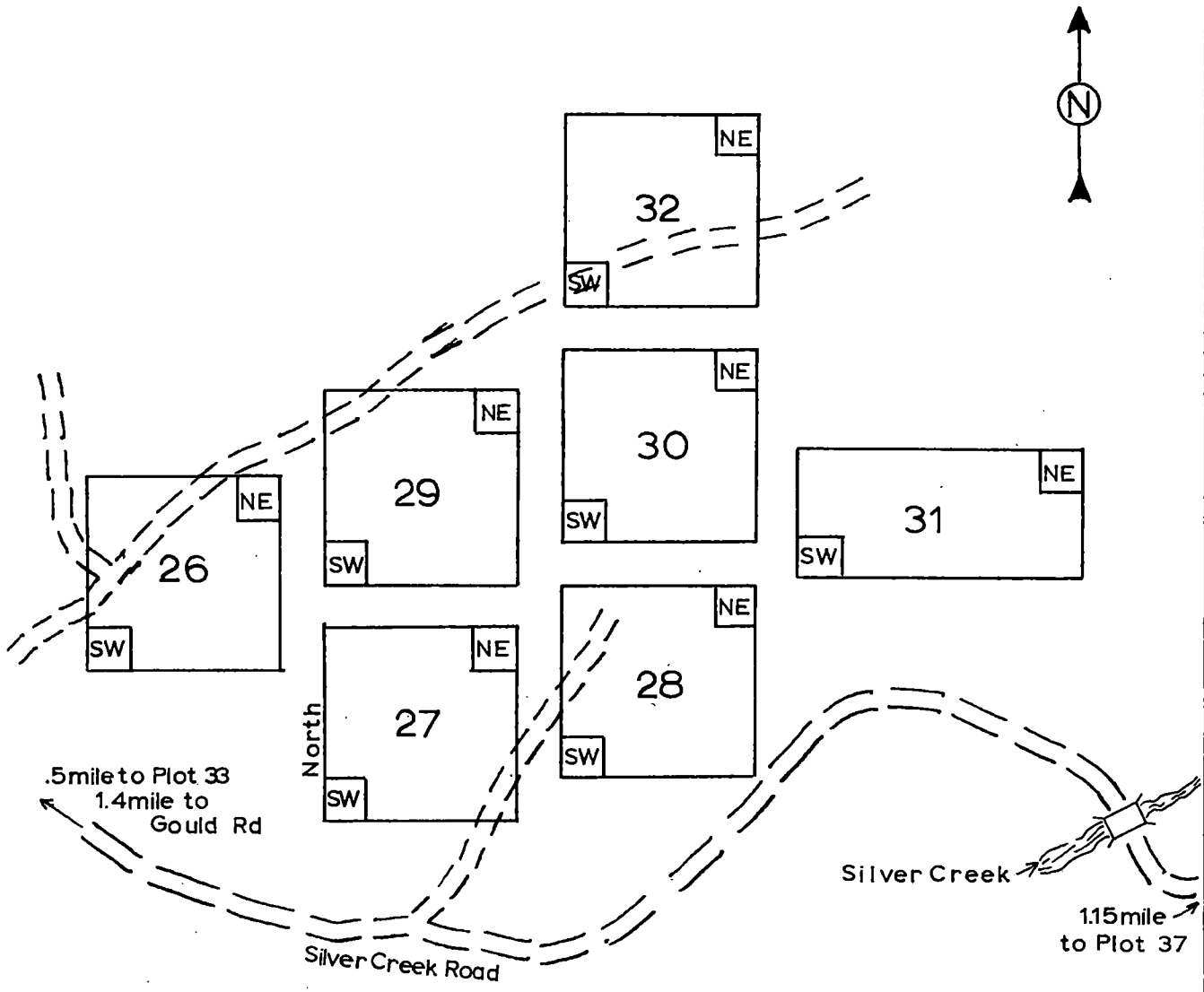
N

Camp Creek Main
Dwarfmistletoe Control Plots
Sec, 25, T12N, R79W, 6th P. M.
Routt National Forest
Established 6/65

Scale: 1 inch = 2 chains



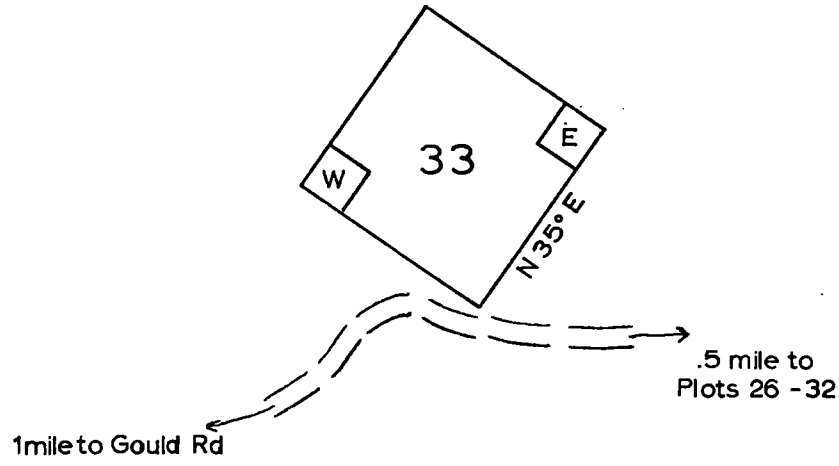
Willow Creek
Dwarfmistletoe Control Plots
Sec. 2, T4N, R 78W, 6th P.M.
Arapaho National Forest
Established 8/65
Scale: 1 inch = 2 chains



Silver Creek Main
Dwarfmistletoe Control Plots
Sec. 13, T 6 N, R 77 W, 6th P. M.
Routt National Forest
Established 6/66

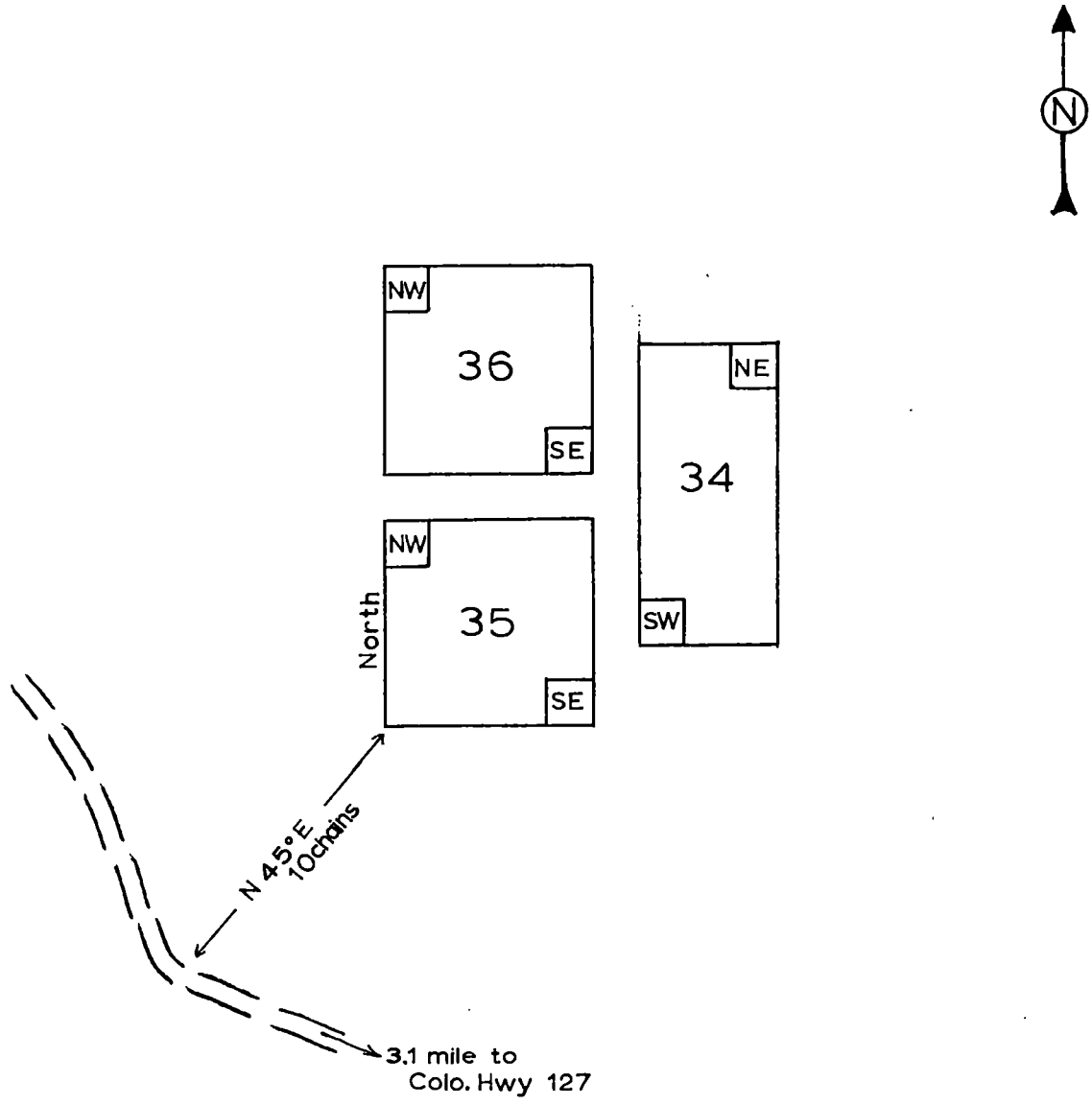
Scale: 1 inch = 2 chains

8



Silver Creek West
Dwarfmistletoe Control Plot
Sec. 14, T 6 N, R 77 W, 6th P. M.
Routt National Forest
Established 6 / 66

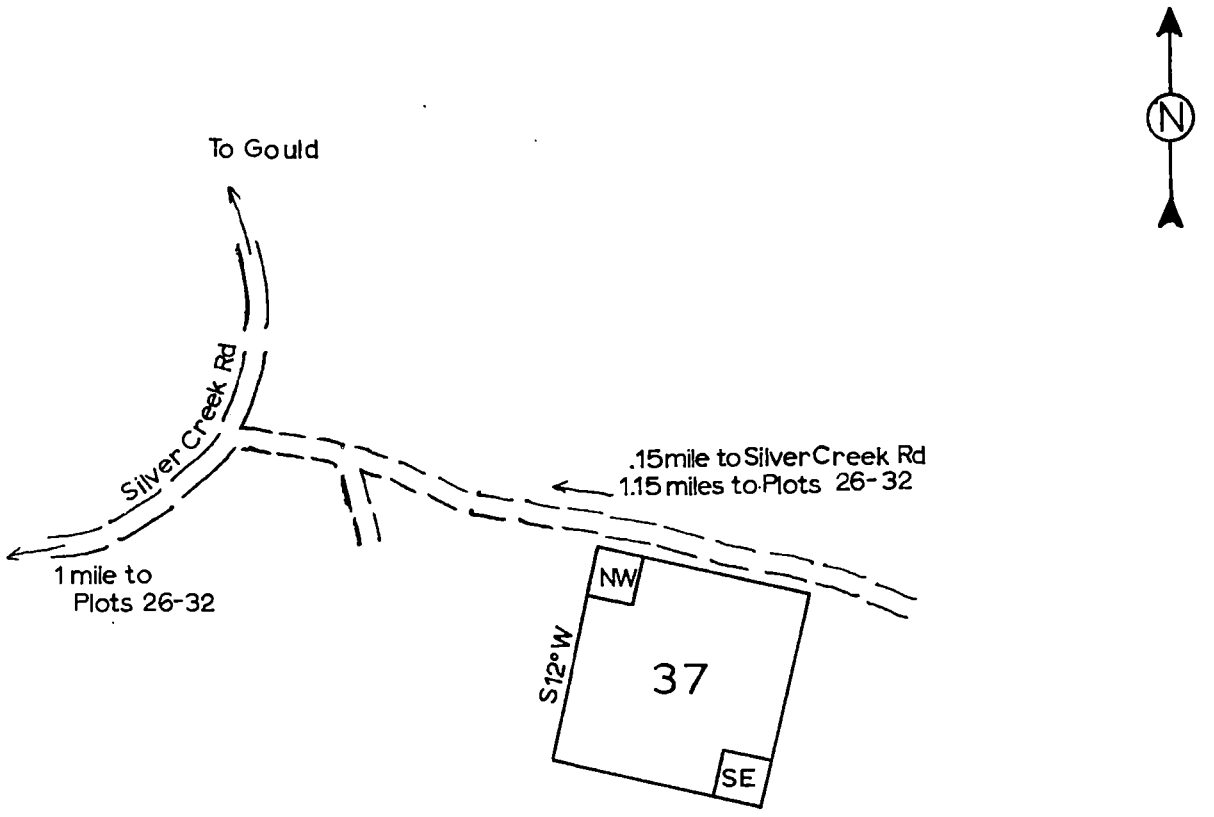
Scale : 1 inch = 2 chains



Bear Draw
Dwarfmistletoe Control Plots
Sec. 26, T12N, R79W, 6th P. M.
Routt National Forest
Established 6/66

Scale: 1 inch = 2 chains

10



Silver Creek East
Dwarfmistletoe Control Plot
Sec 24, T 6 N, R 77 W, 6th P. M.
Routt National Forest
Established 6 / 66

Scale: 1 inch = 2 chains